Performance of canola after two years of wheat under no-till full stubble retention (NTSR) using different drill openers and row spacing at Bungeet

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Key points

- Crusher TT canola yielded between 2.24–2.79 t/ha with 232mm of growing season rainfall (Apr–Oct) and an estimated 118mm of stored available soil moisture (total 350mm).
- All plant populations were high (150–200 plants/m^2) due to an error in calibration, however results produced were similar to previous years, with no significant difference in yield between the narrowest (22.5cm — 2.67t/ha) and widest (37.5cm — 2.75t/ha) row spacings.
- The 30cm spacing yielded significantly lower than both the 22.5cm and the 37.5cm spacings in this trial.
- The disc opener yielded 0.12t/ha more than the tine opener when averaged across row spacings. This yield difference related to higher dry matter production in the disc treatments between pod set and harvest.
- The widest rows (37.5cm) gave the highest harvest index (HI) and estimated water use efficiency (WUE), though the superiority over narrow spacing was relatively small.

Location: Bungeet, Victoria

Rainfall:
- Annual: 621mm
- GSR: 232mm (April – Oct)
- Stored moisture: Estimated 118mm (estimated at 35% fallow efficiency)

Soil:
- Type: Loam over clay, Wattville No.205
- pH (H_2O): 5.9 (2011)
- pH ($CaCl_2$): 5.5 (2011)
- Colwell P: 61mg/kg (2011)
- Deep soil nitrogen: 64kg/ha (2011)

Sowing information:
- Variety: Crusher (TT)
- Sowing date: 22 May 2012
- Fertiliser: 170kg/ha SuPerfect
- Sowing equipment: Janke tine with Janke presswheel. Single disc opener.
- Treatments: Establishment method x row spacing

Row spacing: 22.5cm, 30cm, 37.5cm

Paddock history:
- 2011 — wheat
- 2010 — wheat
- 2009 — faba beans (farm crop)

Plot size: 44m x 3m

Replicates: 4 (disc) 8 (tine)

Overall goal

Improved water use efficiency (WUE) in no-till cropping and stubble retention systems in spatially and temporally variable conditions in the Riverine Plains.

Aim

The aim of this trial was to evaluate the performance of different drill openers at a range of row spacings in the canola crop following two years of wheat under full stubble retention.

Method

A replicated experiment was established on the site of time replicate two (see list below) to test the effect of drill opener and row spacing on canola after two years of wheat as part of a three-year cropping rotation trial. The 2012 crop was the third successive crop superimposed on the original no-till stubble retention trial site using time replicate two.

Time replicate one	Time replicate two
• 2008 wheat (farm crop)	2008 wheat (farm crop)
• 2009 wheat	2009 faba beans (farm crop)
• 2010 canola	2010 wheat
• 2011 wheat	2011 wheat
• **2012 wheat**	**2012 canola**

Crop stubble from the previous year's first wheat crop trial was chopped and spread at right angles to the direction of plots.

Results

Results from the 2012 canola crop, from the time replicate two trial are reported below.

Crop establishment

Canola, which followed two years of wheat, was established at the Bungeet site during 2012. Unfortunately the trial was sown at a rate well above the intended sowing rate of 2.5kg/ha.

Despite this error the trial generated significant differences in crop establishment. The 22.5cm row spacing had significantly better establishment than the 30cm row spacing, which in turn was significantly higher than the 37.5cm spacing.

The drill opener also had a significant impact on crop establishment, with the tine opener providing an advantage in crop establishment.

There was no significant interaction between drill opener and row spacing generated in the trial (see Table 1).

Dry matter production

i) Row spacing

The 22.5cm row spacing produced significantly more dry matter/ha (DM/ha) than the 37.5cm spacing throughout the growing season. However by harvest, the significant difference in DM production between the 22.5cm and 37.5cm spacing was no longer evident and the DM content of the 30cm row spacing was significantly inferior to both the 22.5cm and 37.5cm row spacing (P=0.0114). The DM production of the 30cm row spacing only became inferior at harvest; up until pod set it had been identical to the widest row spacing (see Figure 1).

Previous trials in this series on canola carried out at more conventional sowing rates, showed that DM production peaked at pod set during 2009 at 5500kg DM/ha and during 2011 peaked at 10,000kg DM/ha at harvest. In both previous trial years the disc opener has gained the advantage over the tine opener in terms of DM production at pod set.

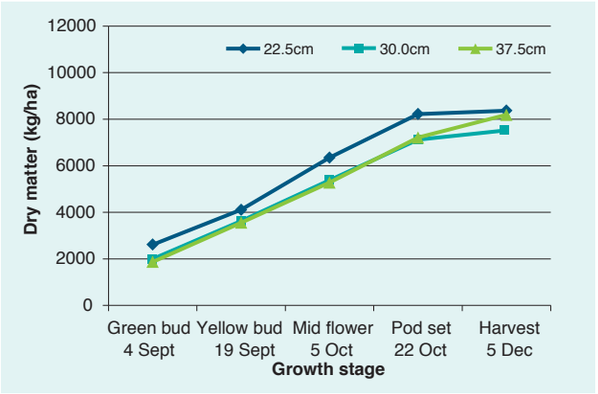

FIGURE 1 Influence of row spacing on dry matter production*
* Mean of both drill openers (4 September – 5 December 2012)

TABLE 1 Canola plant establishment at two-leaves-unfolded growth stage assessed 37 days after sowing at Bungeet

Row spacing (cm)	Drill opener Plant establishment (plants/m²)		
	Disc	Tine	Mean
22.5	215	257	236
30.0	154	170	162
37.5	121	145	133
Mean	**163**	**190**	
LSD [row spacing]	14		
LSD [drill opener]	11		
LSD [disc vs tine]	20		
Interactions — drill opener x row spacing	ns		

ii) Drill opener

There was no significant difference in DM production as a result of drill opener employed until the pod set growth stage. At pod set the disc opener produced significantly more DM/ha than the tine (p=0.0119). The disc opener maintained this significant difference in DM production (p=0.0062) through to the harvest assessment (see Figure 2).

The interaction between drill opener and row spacing in the DM assessment at harvest was nearly significant (p = 0.056), indicating yields from disc openers were less influenced by increasing row width (see Figure 3).

Nitrogen uptake

Nitrogen uptake at green bud was significantly higher at the two narrower row spacings, mainly as a consequence of the higher DM production at the widest (37.5cm) spacing. There was then no difference between the nitrogen uptake of the three spacings until harvest, where the 37.5cm spacing had significantly greater nitrogen uptake than the 22.5cm row spacing. In turn, the 22.5cm spacing had significantly more nitrogen uptake than the 30cm row spacing (p=<0.001) (see Figure 4).

Note that nitrogen content of the crop at pod set was higher than at harvest, a factor most probably linked to loss of larger leaves in the lower canopy before harvest.

Yield

i) Yield

The average yield of the canola trial at Bungeet was 2.59t/ha.

The 30cm spacing was significantly lower yielding than both the 22.5cm and 37.5cm spacings, between which there was no difference.

The disc opener produced higher yields than the tine opener. The 0.12t/ha yield advantage correlated to higher DM in crops established with the disc opener.

There was no significant interaction between row spacing and drill opener on the yields obtained in the trial, with the 30cm row spacing yielding the least with both the tine and disc opener (see Figure 5).

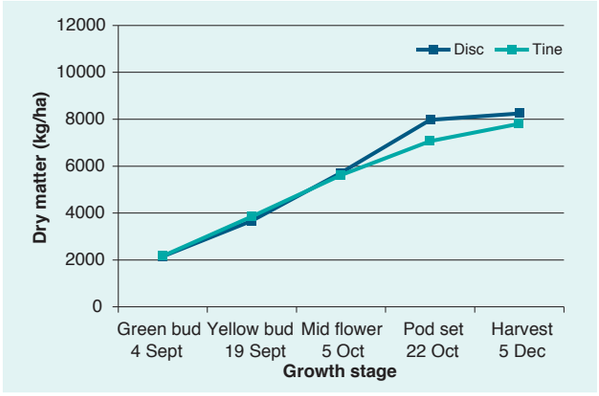

FIGURE 2 Influence of drill opener on dry matter production*
* Mean of three row spacings (4 September – 5 December 2012)

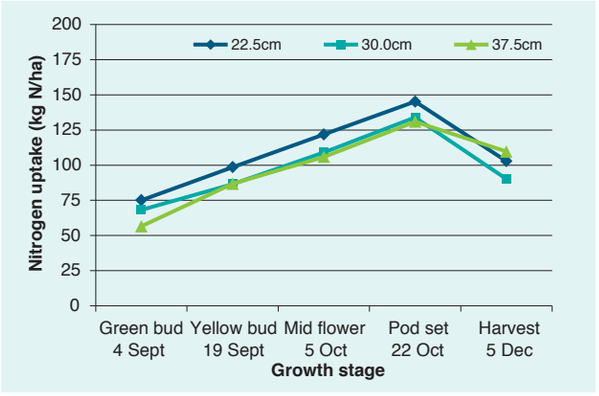

FIGURE 4 Influence of row spacing on nitrogen uptake*
* Mean of both drill openers (4 September – 5 December 2012)

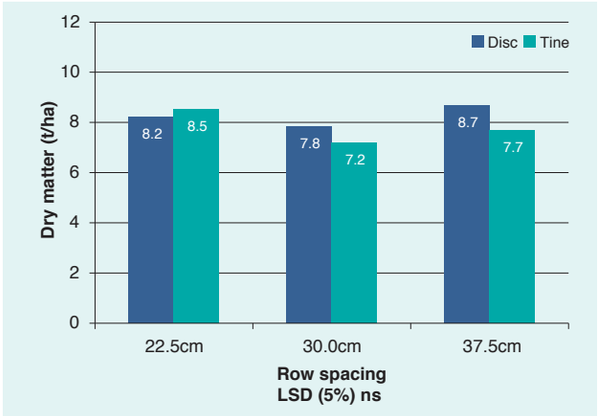

FIGURE 3 Influence of row spacing and drill opener on dry matter production at harvest

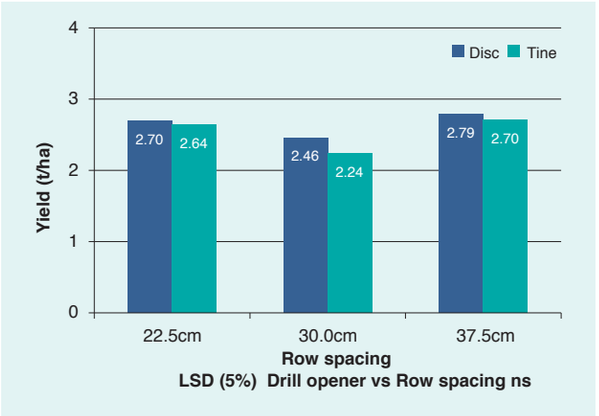

FIGURE 5 Influence of row spacing and drill opener on yield

ii) Oil content

Oil content was not significantly affected by row spacing or drill opener.

iii) Nitrogen off-take

Nitrogen in the seed accounted for about 78–81% of the nitrogen off-take, while straw nitrogen content accounted for about 19–21% of total nitrogen off-take (figures that were consistent across the different row spacings). However, actual seed nitrogen off-take (kg N/ha) at harvest was significantly higher in crops sown at the 37.5cm row spacing compared with those sown at 22.5cm, which were in turn significantly higher than the seed nitrogen off-take of the 30cm crops (see Figure 6).

The difference in seed nitrogen followed through to the total nitrogen off-take results because there were no significant differences between the straw nitrogen contents of the different row spacings.

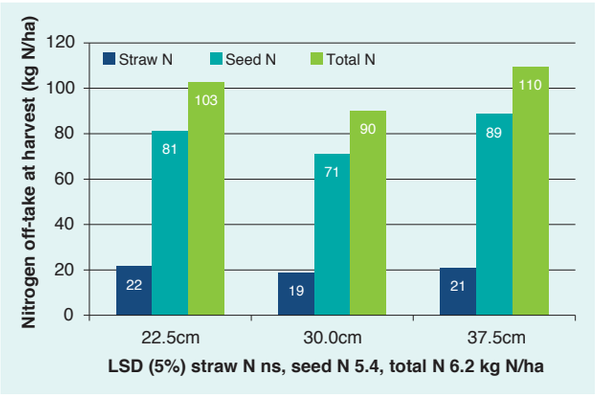

FIGURE 6 Influence of row spacing and drill opener on nitrogen off-take at harvest*

* Mean of both drill openers

Observations and comments

The widest row spacing of 37.5cm produced the highest harvest index, WUE and transpiration efficiency results (see Table 2). Results were slightly superior to the narrowest row spacing of 22.5cm. It is unclear why the 30cm row spacing was inferior to both, though it was linked to lower DM production at pod set and harvest. Unlike the wheat trials, there was less evidence of soil water being underutilised (i.e. less unproductive water) in the wider rows compared with the narrower rows.

Sponsors

This trial was carried out as part of the Riverine Plains Inc GRDC-funded project *Improved WUE in no-till cropping and stubble retention systems in spatially and temporally variable conditions in the Riverine Plains* (RP100007).

Thanks go to farmer co-operator, John Alexander and John Seidel as trial manager.

TABLE 2 Biomass at harvest, yield, harvest index (HI), water use efficiency (WUE), transpiration, evaporation/drainage and transpiration efficiency (TE)*

Row spacing (cm)	Biomass (kg/ha)	Yield (kg/ha)	HI (%)	WUE[1] (kg/mm)	Transpiration[2] (mm)	Unproductive water[3] (mm)	TE[4] (kg/mm)
22.5	8364	2670	31.9	7.6	167.3	182.7	16.0
30	7522	2350	31.2	6.7	150.4	199.6	15.6
37.5	8187	2750	33.6	7.9	163.7	186.3	16.8

[1] Based on 232mm of GSR (April – October) + 35% fallow efficiency (118mm) for January – March rainfall (total GSR + stored = 350mm) with no soil evaporation term included and assuming no drainage in periods of excessive rainfall.

[2] Transpiration through the plant based on a maximum 50kg harvest biomass/ha.mm transpired.

[3] Unproductive water (evaporation, drainage and water left unused at harvest) is the difference between transpiration through the plant and GSR (mm) + stored water at sowing.

[4] Transpiration efficiency based on kg/ha grain produced per mm of water transpired through the plant.

* Mean of both openers

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